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Search for $2p$ decay of the first excited state of ^{17}Ne

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Structure of nuclei located near and beyond the drip-lines plays important role in the explosive astrophysical processes. The problem of two-proton decay of the ^{17}Ne first excited state is a good example of such situation. The two-proton radiative capture is a possible bypass of the ^{15}O waiting point in the rp-process. The rate of this process drastically depends on the $2p/\gamma$ branching ratio of the ^{17}Ne first excited state. The first excited state of ^{17}Ne (with $J^\pi = 3/2^-$) is located only 344 keV above the 2p decay threshold, and its $2p$ decay partial width is much less then the gamma-decay partial width. The existing experimental threshold for the $2p/\gamma$ ratio (0.77 %) [1] is a few orders of magnitude greater than theoretical predictions made for this value (2.5e-6)[2]. Experiments aimed at the measuring such low branching ratio require development of special methods.

In the recent experiment at the ACCULINNA [3] fragment-separator (Flerov Lab. JINR) the two-proton decay of the low-lying states of ^{17}Ne populated in the $p(^{18}\mathrm{Ne}, d)^{17}$Ne transfer reaction were studied. Original combined-mass method was used in the experiment. This method allows to get relatively good energy resolution ($\sigma \sim 130$ keV) without serious restriction on luminosity. As result, new $2p/\gamma$ ratio threshold for the ^{17}Ne $3/2^-$ state equal 0.016(3)% was achieved, that is about fifty times less than existing value. The proposed method is promising for the study of the searched $2p$ decay partial width at level of $\Gamma_{2p}/\Gamma_\gamma \approx 10^{-6}$

[1] [M. J. Chromik, et. al., Phys.Rev. C55 (2002) 024313]

[2] [L. V. Grigorenko, M. V. Zhukov, Phys.Rev. C76 (2007) 014008]

[3] http://aculina.jinr.ru/

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